Winter Soil Processes in Transition

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Warmer winters are leading to a greater frequency of freeze-thaw events and colder soils due to the loss of the insulating snowpack. These factors are subsequently changing the winter soil processes not only the physical, but the biogeochemical processes. Our knowledge on the function of soil biogeochemical processes in cold region environments during the fall-winter and winter-spring transitions and during the non-growing season is limited. In this presentation, we present a process-based understanding of winter processes governing carbon and nutrient transformations in soil of different cold climate regions and how soil and water resources will respond to future climate warming. We will present how the fluxes of carbon and nutrient and soil geochemical activities are influenced by a combination of changes in temperature and oxygen availability and the recurrent development of a physical ice barrier preventing the exchanges during freezing conditions, where the removal of this barrier during thaw conditions increases the rates of carbon and nutrients leaching and production. Our process-based understanding of the winter soil geochemical cycling advances the predictive understanding changes in carbon and nutrient stocks, speciation and fluxes driven by variations in snow cover and freeze-thaw cycles in soils of cold regions during the non-growing season.